An investigation of the longitudinal proximity effect in superconducting and normal metal TES

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As the TES volume and (effective) $T_c$ become very small – for volume $< 10 \text{ mu m} \times 10 \text{ mu m} \times 0.5 \text{ mu m}$ and $T_c < 90 \text{ mK}$ – we approach a regime in which the noise equivalent power is dominated by fluctuations in power dissipating from the TES electrons to its phonons. Our ultimate goal is to build a TES bolometer that operates in this regime to be used for far-infrared and sub-mm astronomy. In this study, we characterize the $R$ vs $T$ behavior of small TES in order to engineer a TES bolometer that has a very low $T_c$. Sadleir et al [1] found that as the distance $L$ between two superconducting leads, with the lead $T_c >>$ the TES $T_c$, connected at opposite ends of TES approaches zero, superconductivity is induced parallel to the current flow, or longitudinally, and results in a much higher effective TES $T_c$. Here we present effective $T_c$ measurements of Mo/Au TES bounded by Nb leads as a function of $L$ which ranges between 4 and 36 mu m. We observe that the effective $T_c$ is suppressed for current density of order $10^{-6}$ A/µm². We also explore the possibility of using a normal metal TES.

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